Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. (Full Time) - END SEMESTER EXAMINATIONS, APRIL / MAY 2025

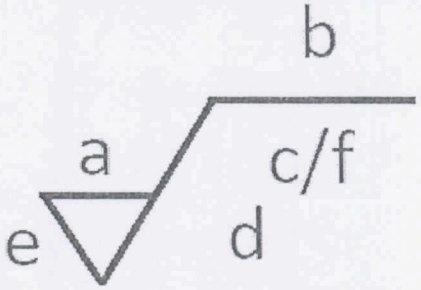
MECHANICAL ENGINEERING BRANCH
Semester - VI
ME5081 Process Planning and Cost Estimation
(Regulation 2019)

Time: 3 hrs Max.Marks: 100

CO1	Create a process plan for a given product.
CO2	Prepare cost elements for a given product.
CO3	Allocate overhead to different departments.
CO4	Estimate the cost for casting, welding and forging.
CO5	Analyze the costs for machining a product.

BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A(10x2=20Marks)
(Answer all Questions)

Q.No.	Questions	Marks	CO	BL
1.	Although a machine tool may be technically capable of performing the required manufacturing operation for a given component, it may still be considered unsuitable for producing the component due to certain limitations. Identify any three such limitations.	2	1	2
2.	 If you were a process planner, what information would you infer from the given surface finish symbol?	2	1	2
3.	What is the difference in how a manufacturing engineer approaches cost estimation when using parametric methods versus analogous methods to estimate the cost of a complex aerospace bracket?	2	2	2
4.	Two similar components have identical material and labor costs, yet their total unit costs differ significantly. Identify four potential cost factors that could contribute to this difference.	2	2	2
5.	A machine is purchased for ₹1,00,000, and after a service life of 5 years, its scrap value is ₹35,000. Using the Sum of Years' Digits (SYD) method, determine the depreciation for the fourth year.	2	3	2
6.	In a certain department, a machine has a mean time between failures (MTBF) of 200 hours and a mean time to repair (MTTR) of 6 hours. The department operates one 8-hour shift per day, 5 days a week. Each hour of	2	3	2

	downtime results in a lost revenue of ₹12,000. Calculate the revenue lost due to downtime during one week.			
7.	In oxy-acetylene welding, post-weld heat treatment is often used to relieve residual stresses. Which torch technique — leftward (forehand) or rightward (backhand) — is preferred when post-heating is required during the welding itself, and justify your choice?	2	4	2
8.	Which forging technique is used to increase the diameter and reduce the length of a workpiece, and what is the method employed to achieve this?	2	4	2
9.	Estimate the standard time for a manufacturing process. The observed time for one cycle of operation is 1.5 min., and the rating factor is 130%. The following are the various allowances as percentages of normal time: Personal allowance = 3.5% Relaxation allowance = 9% Delay allowance = 2%.	2	5	2
10.	A channel is to be cut in a cast iron slab with dimensions 25 mm wide, 35 mm deep, and 300 mm long. The diameter of the milling cutter is 90 mm. Given a cutting speed of 30 m/min and a feed rate of 0.28 mm/rev, find the added table travel to ensure a complete cut.	2	5	2

PART- B(5x 13=65Marks)

(Restrict to a maximum of 2 subdivisions)

Q.No.	Questions	Marks	CO	BL
11 (a)	Compare Retrieval-type and Generative-type Computer-Aided Process Planning (CAPP) systems based on the following aspects: a. Planning Methodology and Logic b. Suitability for Different Types of Production c. Level of Automation and Flexibility d. Ease of Implementation and Adaptability to Design Changes Also, provide flowcharts to illustrate the methodologies of Retrieval-type and Generative-type CAPP systems.	13	1	2
	OR			
11 (b)	i. Formulate a process- material matrix and a process-shape matrix for the following processes. a. Blow moulding b. Filament winding c. Cold Extrusion d. Investment casting	8	1	2
	ii. Present a comparison between High-Speed Steel (HSS) and Carbide cutting tools based on the following parameters relevant to process planning, in table form. a. Cutting speed b. Heat and wear resistance c. Stability under shock loads d. Regrindability e. Tool life	5	1	2
12 (a)	The following cost data relates to the operations of XYZ AutoTech Pvt. Ltd., a company engaged in the manufacture of precision automobile parts for OEM clients, during the period from 1st September 2024 to 31st January 2025. The company adopts a periodic inventory valuation method and follows industry-standard cost classification for financial analysis and planning. As a cost analyst, you are required to prepare a detailed cost statement highlighting the Prime Cost, Factory Cost, Cost of Production,	13	2	3

Total Cost, and the resulting Net Profit for the given financial period, based on the data provided below:

Cost Elements	Amount (₹)
Opening inventory of raw materials (as on 01.09.2024)	18,000
Raw material purchases (steel rods, castings, etc.)	1,95,000
Closing inventory of raw materials (as on 31.01.2025)	29,600
Direct labour (machine operators, fitters)	85,000
Special tooling and machining expenses	7,500
Factory rent, insurance, and statutory taxes	12,500
Utilities consumed in manufacturing (power, compressed air, coolant, etc.)	6,800
Depreciation on CNC and shop-floor machinery	5,400
Routine maintenance of shop-floor equipment	1,200
Salary of floor supervisors and production managers	25,000
Intra-plant logistics and material handling charges	1,800
Administrative staff salaries (accounts, HR, etc.)	42,000
Administrative overheads (communication, IT, lighting)	2,100
Depreciation of office systems and equipment	1,500
General administrative and regulatory expenses	3,200
Sales, marketing, and distribution overheads	8,700
Revenue generated from sales of automobile parts	4,95,000

OR

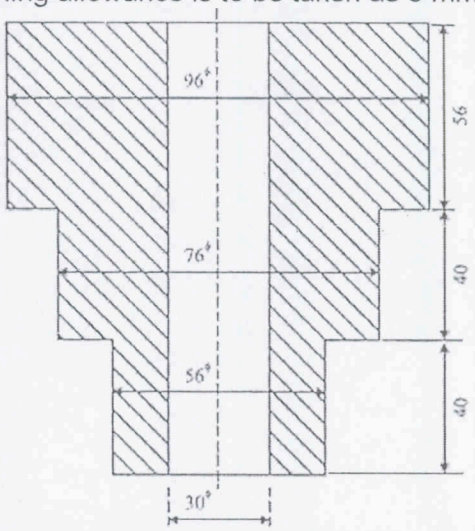
12 (b) A component can be produced with equal ease on either a capstan lathe or on a single spindle cam operated automatic lathe. Draw the break-even chart, determine the break-even quantity and calculate the difference in cost of producing 15,000 components using these machine tools, based on the following information. **13** 2 3

	Item of Expenditure	Capstan lathe	Automatic lathe
i	Tooling cost	₹300	₹400
ii	Cost of Cam	₹0	₹1500
iii	Material cost per component	₹250	₹250
iv	labour cost for operating	₹ 25/hr.	₹10/hr.
v	Cycle time/component	5 min.	2 min.
vi	labour cost for setting	₹40/hr.	₹50/hr.
vii	Setting up time	1 hr.	3 hr.
viii	Setup labour overheads (% of setup labour cost)	250%	800%
ix	Operating overheads (% of operating labour cost)	375%	1000%

13 (a) A vertical machining center was acquired for ₹18,40,000 on 1st January 2010. The cost of erection and commissioning was ₹60,000. The machine is expected to be in use until 31st December 2027, after which it will be scrapped for ₹1,20,000. The applicable rate of interest is 6% per annum. Determine the total depreciation accumulated after 7 years of installation using the following methods: **13** 3 3

i. Standard diminishing balance Method, neglecting interest.

	ii. Annuity Method iii. Sinking Fund Method			
	OR			
13 (b)	Determine the hourly rate for an automated machining cell using the following data: The direct labour rate is ₹18.00 per hour, and the applicable factory overhead rate on labour is 30%. The capital investment in the machine is ₹2,50,000, with a salvage value of ₹60,000 at the end of its 6-year service life. A return on investment of 12% per annum is expected. The applicable factory overhead rate on machine cost is 45%. The machine is planned to operate two 9-hour shifts per day for 260 working days in a year. (i) Compute the appropriate hourly rate for the machining cell under full two-shift utilization. Use the capital recovery factor to account for machine depreciation and investment return. (ii) If the production demand reduces to a single 9-hour shift per day, determine the revised hourly rate. Calculate the percentage increase in the hourly rate and provide a technical explanation for this change, considering fixed cost absorption and reduced machine utilization.	**13**	3	3
14 (a)	A cast iron component is to be manufactured as per the figure shown below (Part dimensions are in mm). The component is obtained after machining the casting. The machining allowance is to be taken as 3 mm on each side.	**13**	4	3

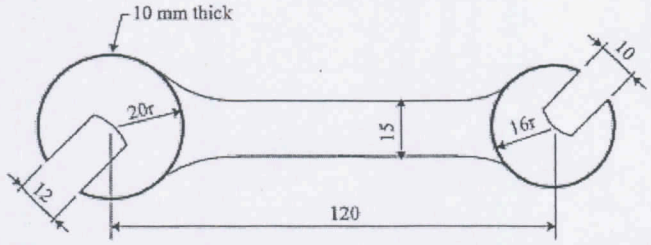
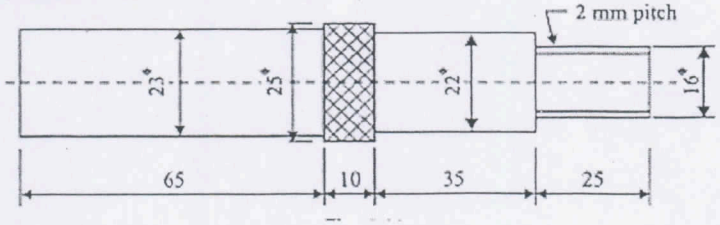


Estimate the selling price per piece from the following data:

i. Density of material = 7.6 g/cc
ii. Cost of molten metal at cupola spout = ₹75 per kg
iii. Process scrap = 20 per cent of net weight
iv. Scrap return value = ₹30 per kg
v. Administrative overheads = ₹60 per hour
vi. Sales overheads = 40 per cent of factory cost
vii. Profit = 25 per cent of factory cost
viii. The pattern which costs ₹8,000 can produce 1,000 pieces before being scrapped.

Other expenditures are:

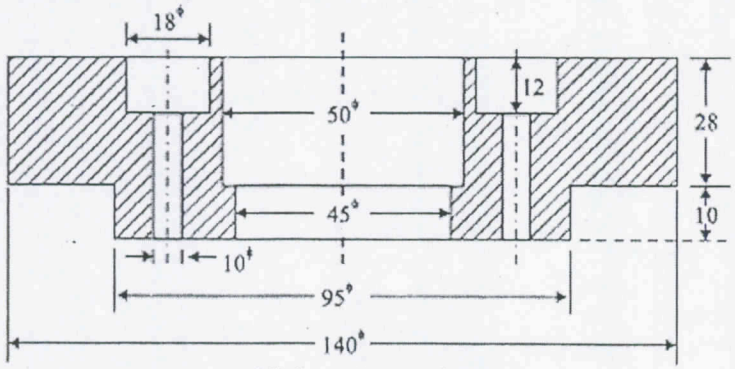
Operation	Time (min.)	Labour Cost/hr.	Shops Overheads/hr.
Moulding and pouring	15	₹50	₹80
Shot blasting	5	₹30	₹45
Fettling	6	₹10	₹35

	OR			
14 (b)	i. Estimate the cost of manufacturing a high carbon steel spanner (as shown in the given part diagram whose dimensions are in mm) to be made by die forging. The following data is available: a. Batch size - 500 pieces b. Die cost per batch - ₹300 c. Stock cutting charges - ₹5 per batch d. Set-up and machine operation cost - ₹75 per batch e. Labour charges - ₹30 per batch f. Density of steel – 8.5 g/cc g. Cost of high carbon steel -₹80 per kg. Consider all possible losses during forging as 24% of the net weight. Assume the cutouts on both the left and right sides and the middle part as rectangular when calculating the gross weight of the component.  	7	4	3
	ii. Estimate the welding cost from the following data: a. Plate thickness = 12 mm b. Form of joint = 60°V c. Root gap = 2 mm d. Length of joint = 2 meters e. Electrode diameters = 3.5 mm and 4.0 mm f. Electrode length = 350 mm g. Electrodes required per meter weld for 90 per cent efficiency and 50 mm stub length = 10 nos. of 3.5 mm dia. and 24 nos. of 4 mm dia. h. Average deposition = 75 per cent i. Melting time per electrode = 1.3 minutes for 3.5 mm dia. and 1.50 minutes for 4 mm dia. electrode. j. Connecting ratio = 2 k. Hourly welding rate = ₹100 l. Overhead charges = 40 per cent of welding cost	6	4	3
15 (a)	i. Estimate the machining time required to manufacture the shaft shown in the figure below, starting from a 26 mm diameter mild steel stock. All dimensions are in mm.  Assume: a. Feed for turning operations - 0.2 mm/rev b. Cutting speed for turning and knurling operations - 20 m/min. c. Cutting speed for threading - 12 m/min. d. Depth of cut not to exceed - 3 mm. e. No. of cuts for threading - 5	7	5	3

	ii. Determine the time required to shape a mild steel block 400 mm × 150 mm on a shaper working with cutting speed of 12 m/min. and cross feed of 0.85 mm/stroke. Ratio of return stroke speed to cutting stroke speed is 3 : 2. Take allowances as 25 mm on length and 5 mm on width.	**6**	5	3
	OR			
15 (b)	i. A medium carbon steel shaft of 35 cm length is to be cylindrically ground from 52.5 mm diameter to 52 mm diameter using a grinding wheel of 50 mm face width. The workpiece rotates at a surface speed of 10 m/min, and the depth of cut per pass is 0.015 mm. Determine the time required to complete the grinding operation	**7**	5	3
	ii. A 300 mm × 50 mm rectangular cast iron piece is to be face milled with a carbide cutter. The cutting speed and feed are 50 m/min and 50 mm/min. If the cutter dia. is 80 mm and it has 12 cutting teeth, determine: a. Cutter r.p.m. b. Feed per tooth c. Milling time	**6**	5	3

PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

Q.No.	Questions	Marks	CO	BL
16.	As a process planner in a precision manufacturing environment, you are assigned with developing a process plan for the component represented in the given diagram. Considering standard machine shop capabilities and tooling availability, prepare a route sheet and a detailed operation sheet that outlines the sequence of operations, machine tools required, cutting tools used, process parameters and approximate time for each operation.  All dimensions are in mm	**15**	1	6